13

REPORTS

OF

MEDICAL INSPECTORS

OF THE

LOCAL GOVERNMENT BOARD.

Dr. R. J. Reece's Report to the Local Government Board on an outbreak of Enteric Fever in the Royal Marine Depôt at Walmer.

ROYAL COLLEGE OF SURGEONS OF ENGLAND
26 MAR 09
LIBRARY

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
BY DARLING & SON, LTD., 34-40, BACON STREET, E.

1909.

Dr. R. J. Reece's Report to the Local Government Board on an outbreak of Enteric Fever in the Royal Marine Depôt at Walmer.

ARTHUR NEWSHOLME,
Medical Officer,
24th February, 1909.

CIRCUMSTANCES UNDER WHICH THE INQUIRY WAS UNDERTAKEN.

On 7th November, 1908, the Lords Commissioners of the Admiralty addressed the Local Government Board on the subject of occurrence of enteric fever at the Royal Marine Depôt, Walmer. And their Lordships requested that one of the Board's Medical Staff should be charged with the duty of investigating the outbreak in question.

DESCRIPTION OF THE DEPÔT.

The Royal Marine Depôt comprises three separate sets of Barracks and a Hospital. These Barracks, styled severally "North," "South," and "East," are situated in the Walmer Urban District; the Hospital is in the Borough of Deal.

To this depôt young men joining the Royal Marines as recruits are sent for eleven months' training antecedent to being drafted to the Royal Marine Head Quarters at Chatham, Portsmouth or Plymouth.

The North Barracks contain six blocks built at different periods. Blocks G, H and J were erected about the year 1800, under the auspices of the War Department. Blocks E, F, & K, of quite different design and construction, in 1896, by the Admiralty.

The South Barracks comprise only two blocks, each divided into two sub-blocks, A and B constituting one block, C and D another. Between the two blocks stands the officers' mess. The buildings in question were erected about the year 1800.

The East Barracks, formerly a Hospital, were converted to present use in 1901. They comprise Blocks L, M, N, O, and P, all parts of one building, and thus differing in design from the blocks in the other Barracks.

Each Barrack is self-contained in a domestic and administrative sense. There are separate kitchens for each Barrack and a separate staff is employed in each kitchen. Each Barrack has its own set of latrines and urinals, bath and washhouses and so forth.

The Hospital is a modern building and consists of an administration block, six ward pavilions, kitchen, laundry, mortuary, &c. There is a high pressure steam disinfecting apparatus, and a small refuse destructor within the Hospital enclosure.

In each of the Barracks and at the Hospital there are separate detached houses for the resident staff, and there are "married quarters" in the South Barracks.

Water Supply.—The water supply to the whole Depôt is a constant service, and is derived from deep wells in the Chalk, situated in the N.W. of the Walmer Urban District. The water works are owned jointly by the Corporation of Deal and the

Walmer Urban District Council, and they serve large populations in these two sanitary areas as well as the inmates of the Depôt. Water is supplied to the Depôt by meter, and the water mains inside the Barracks are arranged so as to supply water to practically every building. Water is laid on to lobbies in the Barrack blocks, the water taps being placed over sinks, which discharge over gullies placed outside the buildings. But no water is laid on to the interior of A, B, C, and D, and G, H, and J Blocks; the water for these three last-mentioned blocks is obtained from two taps placed one between each block in the barrack yard.

Drainage.—There are no drains, other than drains to carry off rain water, to Blocks A, B, C, D, G, H and J. The other blocks have slop sinks which discharge over trapped gullies outside the blocks. All the latrines and urinals and such sanitary conveniences, which are of excellent construction and design, are placed in separate buildings outside the blocks. The superficial drainage of the Depôt, much of which has been renewed of late years, is on the whole in a very satisfactory condition. At night time urine tubs, of galvanized iron, are placed either inside the barrack rooms, in the lobbies, or in the passages outside the rooms, for use by the men in the night. These tubs are emptied the first thing in the morning, and are stored in racks in the barrack yards until again required at night.

Sewerage.—There are two separate sewerage systems at the Depôt. Branch sewers from the southern half of the North Barracks joining with other branch sewers in the South Barrack form a main sewer, which emerges from the N E. corner of the South Barracks. This sewer is conjoined outside the Depôt with Walmer town sewers, and discharges to the sea by an outfall situated below low water mark.

The northern portion of the North Barrack has a system of branch sewers which combine to form a main sewer. This, outside the N.E. corner of the Barrack, is joined by a sewer from the Hospital and further on by a sewer from the East Barrack, and by Walmer town sewers. This main sewer likewise discharges to the sea by an outfall situated below low water mark.

The Barracks sewerage systems were laid down between 1860 and 1870, and it is known that the sewers, which are, in places, many feet below the ground surface (some are at a depth of 20 feet), are in a very unsatisfactory state, and that leakage from them takes place. The subsoil under the Barracks must in places be considerably polluted.

A very large proportion of the northern portion of Walmer Urban District is served by sewers which connect to the two main outfall sewers from the Barracks. The sewage of Deal is carried by a separate system of sewers beyond the northern limits of the Borough, to one outfall which discharges to the sea.

Refuse disposal.—In each Barrack there are places to which the ashes and refuse are taken. Ashes and dry refuse are placed in covered ash pits, refuse, &c., in sanitary bins, and liquid refuse poured down outside gullies. The scavenging is carried out by a contractor, and the refuse is removed daily to a farm in the Eastry Rural District. The work of scavenging is well done.

Life of the Recruit at the Depôt.

The recruit on joining the Depôt is posted to one of several companies lettered from "A" to "G." These companies are kept at an average numerical strength, and live in separate blocks in the three sets of Barracks. He is put into a "squad" for instruction purposes, and in addition to military drill, &c., he is taught physical drill, swimming and boat pulling. The squads generally contain some 40 to 50 recruits, who are passed through the progressive course of exercises. It follows that if several recruits join on the same day, they are all placed in the squad in course of formation, but they may each be in different companies. Each barrack room, or set of barrack rooms, is in charge of a sergeant, generally a married man, and resident in the married quarters, or who lives outside the Barracks. In each barrack room there is a corporal or lance-corporal, or two or more "old soldiers," who teach the recruit his duties in the barrack room, and who are in a measure held responsible for the discipline and order of the room. Each marine sleeps on an iron frame bedstead, and is supplied with a palliasse which consists of a large canvas bag loosely stuffed with straw, a straw bolster, two calico sheets, three white blankets and a brown rug. The sheets are washed once a month, the palliasses and bolsters once in three months and the blankets once in six months, and the brown rugs once a year. Each recruit is required to have two towels, but he may have more. Marines are not required to have a tooth brush.

Daily in each barrack room two recruits are told off as "cooks." These cooks fetch the rations from the kitchens and clean the plates and dishes, &c., after each meal. The meals are served and the washing up afterwards is done in the barrack room. The "cooks" carry the refuse food, scraps, &c , to the refuse bins, and pour the washing-up water down the gullies in the barrack yards, and there wash the various utensils before taking them back to the barrack room. It is also the duty of these recruits to empty the urine tubs in the morning and to place them in the barrack room at night. There is a standing order at the Depôt that these urine tubs are to be emptied in the latrines. There is thus opportunity for the hands of the workers to become soiled. Vegetables and potatoes generally are prepared for cooking in the barrack rooms on the night before these articles are required at the kitchen. The recruits also perform various fatigue duties associated with barrack life, such as assisting the pioneers in cleaning and sweeping parade grounds and barrack yards, and in carrying coal to the barrack rooms, for each barrack room has a fire in an open grate.

In addition to the recruits there is a single company, "H" Company, of "old soldiers" quartered in a separate block in East Barracks.

Population.—At the beginning of August, 1908, there were resident at the Depôt:—

In married quarters In staff houses In Hospital	91 men, 83 women, and 115 children	289
In North Barracks,	110 old soldiers, 519 recruits ...	629
In South Barracks,	54 old soldiers, 211 recruits ..	265
In East Barracks,	54 old soldiers, 125 recruits ...	179

In addition there were 311 persons (303 men, 8 women) who, though employed within the Depôt, lived and slept outside the establishment.

In all therefore there were 855 recruits, 218 old soldiers, and 600 other adults and children, a population of near upon 1,700 persons, presumably exposed to such cause of enteric fever as might have been operating within the Depôt in the early autumn of this year.

THE FEVER.

With one single exception* no person belonging to or employed in the Depôt but residing outside the Barracks, suffered enteric fever in the outbreak which is the subject of this report. The Barracks alone became implicated, and the Barracks population, old soldiers and recruits, numbering 1,073 persons, was on the 1st August distributed block by block, company by company, and room by room, in the several Barracks as follows :—

Table I.—Showing the population on 1st August, 1908, as distributed in Block, Company and Rooms in the several Barracks.

South Barracks.

"Cavalry" Barracks.				"A" Block.				"B" Block.				"C" Block.				"D" Block.			
"H" Company.				"A" Company.				"A" Company.				"B" Company.				"B" Company.			
Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.
4	4	—	4	1	1	11	12	1	3	11	14	1	2	13	15	2	2	10	12
—	—	—	—	2	3	10	13	2	2	13	14	2	2	13	15	3	4	10	14
—	—	—	—	3	2	9	11	3	3	8	11	3	2	9	11	5	1	8	9
—	—	—	—	5	1	8	9	5	2	12	14	5	3	8	11	6	2	5	7
—	—	—	—	6	2	9	11	6	2	7	9	6	3	8	11	8	2	7	9
—	—	—	—	8	3	7	10	8	1	9	10	8	2	7	9	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
—	4	—	4	—	12	54	66	—	13	59	72	--	14	58	72	—	11	40	51

North Barracks.

"E" Block.				"F" Block.				"G" Block.				"H" Block.				"J" Block.				"K" Block.			
"C" Company.				"D" Company.				"C" & "D" Companies.				"E" Company.				Receiving Room for Recruits' Band.				"F" Company.			
Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.
1	1	14	15	1	2	15	17	7	2	20	22	1	2	19	21	1	2	—	2	1	—	16	16
3	2	14	16	3	2	13	15	9	1	17	18	3	1	19	20	3	18	—	18	3	2	13	15
5	2	15	17	5	—	13	13	—	—	—	—	4	4	20	24	4	15	—	15	5	3	14	17
6	2	14	16	6	3	13	16	—	—	—	—	6	3	20	23	—	—	—	—	6	4	12	16
8	3	11	14	8	2	14	16	—	—	—	—	7	3	20	23	—	—	—	—	8	3	13	16
10	2	15	17	10	2	13	15	—	—	—	—	9	3	21	24	—	—	—	—	10	3	13	16
11	2	15	17	11	1	15	16	—	—	—	—	—	—	—	—	—	—	—	—	11	1	12	13
13	2	15	17	13	3	11	14	—	—	—	—	—	—	—	—	—	—	—	—	13	2	12	14
15	2	13	15	15	3	11	14	—	—	—	—	—	—	—	—	—	—	—	—	15	2	14	16
—	18	126	144	—	18	118	136	—	3	37	40	—	16	119	135	—	35	—	35	—	20	119	139

---

* This single exception was a Lance-Corporal who fell ill at a late stage of the outbreak. (*See* Appendix IX.)

TABLE I.—*continued.*

EAST BARRACKS.																			
"L" Block.				"M" Block.				"N" Block.				"O" Block.				"P" Block.			
Unoccupied.				Unoccupied.				"G" Company.				"H" Company.				"G" Company.			
Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.	Number of Room.	Old Soldiers.	Recruits.	Total.
								1	1	13	11	1	6	—	6	2	2	14	16
								4	2	14	16	4	10	—	10	5	1	15	16
								5	2	17	19	5	10	—	10	6	1	13	14
								6	2	17	19	8	9	—	9	9	1	9	10
Unoccupied.				Unoccupied.				—	—	—	—	9	7	—	7	10	—	13	13
								—	—	—	—	—	—	—	—	—	—	—	—
								—	—	—	—	—	—	—	—	—	—	—	—
								—	—	—	—	—	—	—	—	—	—	—	—
								—	7	61	68	—	42	—	42	—	5	64	69

Upon these Barracks, incidence of enteric fever in the months of August, September, October and November, occurred as follows :—

TABLE II.

——	North Barrack.	South Barrack.	East Barrack.
Inmates	629	265	179
Cases	30	2	1
Date of earliest case ...	4 August	7 October	27 September

All these attacks were among recruits, and the distribution of the fever cases among the several blocks and rooms of Barracks was :—

TABLE III.

Barrack	NORTH.																	SOUTH.					EAST.		
Block	E					F			G		H				K			No. of other Blocks occupied but not invaded.	A		C		No. of other Blocks occupied but not invaded.	N		No. of other Blocks occupied, but not invaded.
																		One.					Three.			Two.
Rooms	Distinguishing Number of invaded Room.				Number of other occupied rooms not invaded.	Distinguishing Number of invaded Room.		Number of other occupied rooms not invaded.	Distinguishing Number of invaded Room.	Number of other occupied rooms not invaded.	Distinguishing Number of invaded Room.			Number of other occupied rooms not invaded.	Distinguishing Number of invaded Room.		Number of other occupied rooms not invaded.	Number of occupied Rooms.	Distinguishing Number of invaded Room.	Number of other occupied rooms not invaded.	Distinguishing Number of invaded Room.	Number of the occupied rooms not invaded.	Number of occupied Rooms.	Distinguishing Number of invaded Room.	Number of other occupied rooms not invaded.	Number of occupied Rooms.
	3	5	6	11	Five	1	15	Seven	9	One	4	6	7	Three	6	15	Seven	Three	3	Five	2	Five	Twelve	5	Three	Ten
No. of Persons in the Rooms.	16	17	16	17	78	17	14	105	18	22	24	23	23	65	16	16	107	35	11	55	15	57	127	19	49	111
No. of Cases of Enteric Fever in the Room.	1	1	1	1	—	1	1	—	2	—	12	3	5	—	1	1	—	—	1	—	1	—	—	1	—	—

Upon the several Companies the incidence of fever was :—

TABLE IV.

Company	A	B	C	D	E	F	G	H Old Soldiers.	Band.
Number of men in the Company.	138	123	166	154	135	139	137	48	33
No. of cases of Enteric Fever in the Company.	1	1	4	4	20	2	1	—	—

It thus appeared that over the whole period, August to November, the fever, though invading all Barracks and affecting all companies comprising recruits, was in large measure limited to North Barracks and attacked in especial degree E Company, occupying H Block therein, more particularly inmates of Room 4. And question therefore arose, whether conditions obtaining, perhaps peculiar to, Block H were responsible for inception and maintenance of the fever at the Depôt, and for spread of it elsewhere within blocks and Barracks ; or whether, an influence causative of fever having from the first had wider range than H Block and Room 4, the special incidence of the malady on this section of the Barracks was due to local conditions exceptionally favourable to spread of the disease therein.

Accordingly, study was undertaken of the fever in two separate groups of attacks, an August-September series, and an October-November series, with a view to determining which of the above possible explanations appeared most in accordance with the detailed facts of the outbreak. In this way the following data were obtained :—

TABLE V.

Attacks in	Number of cases in each instance in—		
	Company.	Block.	Room.
August and September.	E (3)	H (3)	4 (2)
			7 (1)
	D (3)	G (2)	9 (2)
		F (1)	1 (1)
	C (1)	E (1)	6 (1)
	F (1)	K (1)	6 (1)
	G (1)	N (1)	5 (1)
October and November.	E (17)	H (17)	4 (10)
			7 (4)
			6 (3)
	D (1)	F (1)	15 (1)
	C (3)	E (3)	3 (1)
			5 (1)
			11 (1)
	A (1)	A (1)	3 (1)
	F (1)	K (1)	15 (1)
	B (1)	C (1)	2 (1)

These data show that the specialty of incidence of the fever on a particular company, block and room, which has been noted, did not become manifest until the outbreak was well established; that antecedently to October no less than five companies were implicated, six blocks attacked, and seven rooms invaded.

In view therefore of this wide range of the fever prior to its exceptional incidence on Block H, Room 4, the earlier cases of the outbreak, *i.e.*, those occurring in August-September, and nine in number, become of special interest. They were accordingly subjected to strict scrutiny for the purpose of ascertaining what conditions of a nature possibly to cause fever had been common to these nine persons, but not shared, or only sparsely shared, at the same time by a great number of other persons who wholly escaped illness.

Some essential facts respecting the nine specially in question are recorded in the subjoined table. Parallel facts as to other sufferers by the outbreak are for convenience relegated to appendix (Appendix I.):—

TABLE VI.

Number of Case.	Age.	Rank.	Company	Squad.	Barracks.	Barrack Block and Number of Room.	Date on which the Marine joined the Depôt.	Approximate Date of the Onset of the Illness.	Date of Admission to Hospital.
							1908	1908	1908
1	19	Recruit	E	66	North	H 4	6 March	4 Aug.	26 Aug.
2	17	,,	D	63	,,	G 9	28 Jan.	8 ,,	20 ,,
3*	26	,,	D	67	,,	G 9	2 July	25 ,,	9 Sept.
4	18	,,	C	67	,,	E 6	9 May	16 Sept.	7 Oct.
5	17	,,	F	68	,,	K 6	5 June	17 ,,	21 Sept.
6	17	,,	E	71	,,	H 7	25 July	27 ,,	28 ,,
7	20	,,	G	66	East	N 5	30 April	27 ,,	29 ,,
8	18	,,	D	67	North	F 1	19 May	28 ,,	1 Oct.
9	17	,,	E	64	,,	H 4	29 Feb.	28 ,,	9 ,,

* Ex-bugler.

I.—AGENCIES POSSIBLY OF FEVER OPERATING *within* BARRACKS.

A.—*Date of joining the Depôt.*

The nine patients in the first series joined at varying dates, but in every case the date is consistent with the person having acquired fever after joining the Depôt.

B.—*Water Supply.*

After study of all the circumstances of water service, water supply as a vehicle for the introduction of the infection appeared to be definitely excluded. (*See* Appendix II.)

C.—*Drainage and Sewerage.*

No circumstances were discoverable of a sort in any way to connect fever occurring among the recruits with the defects in the sewerage arrangements of the Depôt, nor by medium of Depôt drainage with other sewerage serving the civil population. Antecedent to fever in the Depôt, cases of the disease no doubt occurred in Walmer; but none of the sewers of this urban district pass through or under the Barracks. Commingling, therefore, of Barrack sewage with town sewage takes place only in outfall sewers outside the Depôt.

D.—*Food and Drink.*

(a.) *Officially provided.*—On consideration of all the available facts the conclusion was arrived at that the cause of the outbreak of fever was not associated with the food and drink officially provided at the Depôt. (*See* Appendix III.)

(b.) *Food and Drink from unofficial Sources.*—These other possible sources of infection by food were, from their nature and multiplicity, less satisfactory to deal with. Recruits, when they join a Depôt, receive pay which allows them 11½*d.* a day to spend. This sum enables them to add to their dietary, and with it they buy extra jam, butter, cheese, and so forth. To check these additional sources of possible infection was therefore a difficult matter.

Some of these food articles, concerning which special inquiry was made, were partaken of by the patients on dates which, if they were infective, were consistent with such articles having conveyed enteric fever. But no single such article could account for infection of more than one or, perhaps, two of the nine persons, and, collectively, they would fail to account for all of them. (*See* Appendix IV.)

E.—*Clothing.*

Officially, all repairs to uniforms are required to be done at the master tailor's shop inside the Barracks. But nearly all the old soldiers are handy men with the needle, and in practice many of the minor repairs to clothing, such as turning and repairing trousers, are done by the old soldiers in the barrack room. Occasionally, too, clothes find their way to unofficial tailors outside the Depôt. I ascertained that certain garments of one of the nine cases of the first series were at the house of a tailor outside the Barracks at a time when the tailor's son was suffering attack by enteric fever, and while he was nursing this son. It is conceivable that this patient could have acquired his infection from the clothes after they were returned to him by the tailor. But in this way only one of the nine cases could be accounted for. (*See* Appendix V.)

F.—*Opportunities for personal infection from case to case.*

Under the conditions in which the Marines live, constantly and intimately associated as they are in the barrack room, and using many things in common, there is no doubt of the possibility of infection of enteric fever being transferred from man to man. As regards the first series of cases it is perhaps probable that the second case which occurred in G Block, Room 9 (case 3), derived infection from the first case in that room (case 2). Possibly also the ninth case might have been infected from the first case of the series. Both of these cases (1 and 9) occurred in H Block, Room 4, but the date of onset of attack in the ninth case tends rather to exclude this explanation. As regards other cases in the first series, "secondary" infection in the barrack rooms does not satisfactorily account for them. These cases were all in separate rooms. Afterwards, when the fever was fully established in a given room direct infection from antecedent cases probably had opportunity to operate to a considerable extent. (*See* Appendix VI.)

G.—*Antecedent cases as possible carriers of the disease within Barracks.*

Inquiry with regard to such cases yielded a negative result. (*See* Appendix VII.)

II.—AGENCIES POSSIBLY CAUSATIVE OF FEVER OPERATING ON PARTICULAR PERSONS *outside* BARRACKS.

A.—*Visits of individual Sufferers to infected localities and personal relation of any of them with antecedent cases.*

Particulars of the cases of enteric fever which were notified during the year in the sanitary districts of Deal and Walmer, and in the Eastry Rural District, which abuts on these districts, were obtained from the Medical Officers of Health of these three districts (*see* Appendix VIII.). No connection between any cases in the first series and known cases outside the Barracks could be traced with the exception of the single case set forth in Appendix V.

It is quite the exception to find a recruit admitting having practised regular excursions into the country or to the neighbouring villages and towns. The great majority of recruits seldom appear to go outside the Barracks except for a stroll along the sea front. Recruits who can ride bicycles take an occasional ride, generally going to Sandwich or Ramsgate. Of the nine cases in the first series only two were accustomed to go outside Deal and Walmer. Of these, one had a sweetheart in service in Deal, and on alternate Sundays these two persons rode on bicycles to a neighbouring village where the girl's parents resided. No cases of enteric fever had occurred in this village. The other patient frequently visited a family resident in the village of Mongeham. Cases of enteric fever occurred in this village, but at a date considerably later than that on which this marine was attacked. No cases occurred in the family which he visited.

B.—*Possibility of infected food or drink having been partaken of by the Nine First Cases outside the Barracks, whether or not in infected dwellings or localities.*

None of these nine cases visited any known infected locality; and although one or two had taken an occasional bicycle ride, they had, they affirmed, not partaken of food or drink on their excursions. So far as could be ascertained only the two recruits mentioned in the paragraph above (A.) had partaken of food or drink outside the Barracks.

C.—*Possible exposure of the Nine Cases in the first series as members of groups or squads to some source or sources of infection as an incident of their training as recruits.*

Examination of the work done day by day in weeks antecedent to their illness by each of these nine men, revealed only two matters in which, as means whereby infection might have been acquired, the work carried out by them differed from that shared by probably all the recruits in the Depôt.

As regards the first of these matters. At one period of the recruit's service he is camped out for a week for instruction in musketry; but only those men are camped out whose lot it is to do their musketry course in the summer. Seven of the nine cases of the first series had not, however, been through this course of instruction.

The other subject for consideration in this connexion was the instruction the recruits receive in swimming,—a condition which it is proper to note had already come under suspicion of the Authorities as possibly concerned in causation of the fever.

A recruit at a certain period of his training is relegated with his squad to the swimming bath for instruction. When certain swimming tests have been complied with he ceases to swim officially. Thus it may happen that a recruit who has learnt to swim before he joins the Depôt, and who is a good performer in the water, may pass out the first day that he is under instruction. In that case it is usual to select such man and pass him through a special course of instruction in "life saving." As far as possible some eight of the best swimmers in every 50 recruits go through this life saving course. This course is carried out in the swimming bath. But all the swimming practised at the bath does not take place under instruction. When a man has passed the swimming tests, or if a recruit be a good swimmer and the squad to which he belongs has not yet reached the period of training at which it goes to the swimming bath, he is at liberty to attend the swimming bath voluntarily on certain days at specified hours. Such voluntary attendances are not, however, recorded for the man, but only credited to the company to which he belongs. On the other hand a recruit who fails to learn to swim by the time that the greater number of his squad have passed in swimming instruction, is transferred to another squad which has not been long under instruction or is just commencing the swimming course.

The nine cases in the first series were attached to six different squads, with an average of 55 men in each, and were distributed as follows :—

TABLE VII.

No. of Squad...	63	64	66	67	68	71*
No. of recruits in the Squad on 1st August, 1908.	48	59	48	67	52	57
No. of patients in the Squad ...	1	1	2	3	1	1

* Squad was not formed until 15th August, 1908.

The first two cases were in squads 66 and 63. Both these men had proved indifferent performers in the water, and both had some time before commenced their swimming in other squads (65 and 62); both had been transferred on account of their inability to learn to swim; and accordingly both were under instruction at the time of their attack by the fever.

The third case was in squad 67. He, however, affirmed that he had never entered the swimming bath, though able to swim before he joined the Depôt. He was an ex-bugler, who had reverted to the status of a recruit in order to qualify as a marine. This man was the second case in Block G, Room 9, and as has been shewn, he not improbably contracted the fever in this barrack room. (*See* p. 11.)

The fourth case was in squad 67; he began to swim on 24th August, and was still under instruction when he first felt ill on 16th September.

The fifth case was in squad 68, and had only commenced to swim on 7th September; he refers his first feeling of illness to 17th September, and he was admitted to Hospital on 21st September.

The sixth case was in squad 71 that was constituted on 15th August and which did not come under swimming instruction during the period under consideration. He, however, was a good swimmer, and attended the bath voluntarily. It has been possible to fix the dates of three such attendances by him, viz., September 7th, 14th, and 21st. He was attacked 27th September.

The seventh case was in squad 66. He began swimming under instruction on 4th August, and he was still under instruction when attacked by fever on 27th September.

The eighth case was in squad 67. He first attended the swimming bath on 24th August, and was under instruction when he was taken ill on 28th September.

The ninth case was in squad 64. He passed the swimming tests and was excused further attendance at the bath on 24th July, but he subsequently attended the bath as a voluntary swimmer.

Use of the swimming bath two to three weeks antecedent to attack was therefore certainly common to all but one of the nine cases in the first series. The other eight were recruits comprised in six squads, members of which were at that time practising swimming either in the course of their instruction or voluntarily. At the period in question these squads included about 330 men, whereas at this same time men included in other eight squads *not* practising swimming numbered some 400 persons. Of the "swimmers" not less than eight were attacked in August–September; of the "non-swimmers" none but the ex-bugler who was inmate of Room 9, Block G.

In view therefore of the evidence already adduced as to unlikelihood of opportunity for infection of the first sufferers by the outbreak in commonly understood ways, presumption arises that these persons may have acquired their enteric fever in connexion with their swimming practice, if only the conditions involved in this swimming had been such as possibly to expose them to risk of infection with the material of that disease.

DESCRIPTION OF THE SWIMMING BATH.

The Swimming Bath is situated on the sea shore in front of the East Barrack, and the building which contains and covers it is substantially constructed of brick. In addition to the actual bath, this establishment comprises urinals and water-closets for the use of the swimmers. These discharge through a drain to the main sewer. There are also provided boilers for generating steam for warming the water in the bath. The establishment is in charge of a senior non-commissioned officer, who resides in it.

The following are the dimensions of the actual bath:—

Measurements.

	ft.	ins.	
Length at top	65	0	
Length at bottom	63	6	
Width at top	28	0	
Width at bottom	26	6	
Depth at shallow end	5	0	to top of bath.
Depth at deep end	8	0	to top of bath.
Depth of water at deep end ...	7	0	
Depth of water at shallow end ...	4	0	

Capacity.

Maximum, *i.e.*, to top	70,000 gallons.
To average water level (1 foot below top)...	59,000 gallons.
Approximately	60,000 gallons.

The bath is filled with sea-water by inflow on a rising tide through an iron pipe 12 inches in diameter, controlled by a penstock. It is emptied periodically through the same pipe by gravitation at, or about, the time of low water. The water in the bath is warmed by driving jets of steam into it below the surface level. There exists an order that the temperature of the water must not fall below 70° Fah. Accordingly, preparatory to swimming exercise, the water is heated to about 75° Fah., to allow for cooling during use of the bath.

The swimming bath intake pipe is situated on the beach 116 yards to the north of the main outfall sewer which discharges sewage from a portion of Walmer Urban District, the East Barrack and the Hospital, and the northern half of the North Barrack. It is 500 yards to the north of the main outfall sewer which receives sewage from the southern half of the North Barrack, the South Barrack, and a considerable portion of the Walmer Urban District.

At this part of Kent, the coast line, facing eastwards, runs almost due north and south. The beach has a steep gradient and is composed of shingle. Accordingly, for discharge at low water, the outfall sewers have not needed to be carried any great distance seaward. Like the inlet pipe to the swimming bath they terminate on the beach, and they are said to be uncovered at exceptionally low tides.

The swimming bath, as has been said, is filled on a flowing tide, but it is so constructed that it cannot be filled to the full except on the rising tide. It cannot be filled at all when the ebb is established.

The flowing tide sets northwards along the coast, with a direction shorewards along the beach, an in-current which is continued for two hours after high water, notwithstanding that the level of the sea is falling with the ebbing tide.

From time to time considerable nuisance is occasioned along the sea front from deposit on the beach of ordure derived from these outfall sewers. This fact is notorious and needs not to be insisted on.

During my three weeks stay at Walmer I had abundant opportunity of observing the effects of flow of sewage from the several outfall sewers. I resided on the first floor of a house which directly overlooks the outfall of the main sewer after it has passed from the South Barrack and has received much sewage from the Walmer Urban District.

In calm days at low tide and slack water, the sewage could be seen as a brown pear-shaped expanse, sharply differentiated from the surrounding sea. With a flowing tide this sewage would stretch away to the northward, parallel to the beach, in a brown stream, and joining with that discharged from the North Barrack sewer, would pass on through the piers of Deal Pier. At almost all states of the tide the position of the sewage in the sea could be accurately gauged by the large number of gulls which fed on it ; I have seen these gulls floating on the water in a long line, beginning at the outfall of the sewer opposite the house where I was residing and stretching away to the north beyond Deal Pier.

Instruction in the swimming bath had been suspended on 27th October, 1908, and at the time of my visit the bath was empty. At my request the bath was filled in my presence. The water as it entered had an appearance very similar to storm water such as may be seen running in the gutters of a London street after heavy rain. The index divisions on an ivory rule could not be read more than half an inch below the surface of the water. Allowed to remain at rest for two or three days, the water clarifies very considerably by sedimentation. This sediment is in the main rather dark sea sand, but the lowest layer of this sand is a greyish black colour, and contains small blackish grey particles of material which smell offensively. When some fifty recruits are at one time learning to swim in this bath, this sediment must be constantly stirred up.

The iron intake pipe of this bath can be seen at low tides ; the beach in its neighbourhood is composed of shingle. In endeavour to ascertain whence the greyish black deposit in the bath was derived, holes were dug in the beach near the seaward end of this pipe. After digging through a few feet of shingle, a layer of mixed shingle and sand was met with at lower level than the orifice of the pipe. This layer was only a few inches in thickness, but it was very hard, having almost the appearance of a layer of concrete. Below this the sea sand was clean. A similar hole dug by the side of the sewer outfall showed clean shingle, but below the "concrete-like" layer this sand was black and smelt offensively.

There is provided in the North Barrack a water-tank raised on brick supports, and holding 8,700 gallons of fresh water for use in case of a fire breaking out in the Barrack, and for flushing twice a week the North Barrack sewer. The swimming bath likewise is emptied twice a week. This is done on Wednesdays and Saturdays, on which days it is washed out with fresh water from the fire-hose, the jet of water from which has considerable force. In addition the bath is scrubbed out on Saturdays. It is filled again on Wednesdays or early on Thursdays, and on Saturday night or Sunday, as the tide serves.

CONSIDERATIONS ARISING FROM THE FOREGOING DATA.

It is obvious from the foregoing that if the swimming bath has persistently acted as an agent of infection, its ability so to act must have been, in view of the cleansing operations practised, renewed from time to time, satisfactorily to account for the incidence of the fever in the several months of its persistence at the Depôt. Having regard, however, to what has been recorded of the physical circumstances of the beach at the mouth of the bath-intake, to the conditions alike of the bath water and the sediment therefrom, and especially to the relations of bath intake and sewer outfalls, there can be little doubt that the water of the bath on each occasion of filling was liable to contain organic impurity derived more or less directly from sewage.

How far such impurity had opportunity of comprising specifically infected material has now to be seen.

From Appendix VIII. it would appear that in the Walmer Urban District excreta of enteric fever patients passed untreated to the sewers discharging 500 yards from the bath intake, from the middle to the end of the month of May, and again from about 21st June to near the end of July; and that subsequently to the 4th August, the date of the first attack at the Depôt, untreated enteric fever excreta of persons falling ill within the Barracks were passing by way of the North Barrack sewer to a point on the beach distant not much more than one hundred yards from the swimming bath intake.

Upon a balance of considerations therefore the presumption which had arisen that conditions involved in swimming bath practice had had much to do with the earlier occurrence of fever in the Barracks, is by no means set aside. On the contrary, many facts that have been accumulated go far to encourage suspicion that the swimming bath has been responsible not only for earlier but for later cases also; for some of those for instance due to infection received after the North Barrack drains were themselves contributing their quota to excremental fouling of sea water and foreshore in the immediate neighbourhood of the swimming bath intake.

From this point of view the following table, which has been compiled from data in my note-books and from facts included in this report and its appendices, may prove of interest;—

Table VIII.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Number of Case.	Under Swimming Instruction.		Attended Swimming Bath Voluntarily before coming Officially under Instruction or after Completion of Swimming Course.	Date of Onset of Enteric Fever.	Date of Removal to Hospital.	Onset of Fever after last Swimming occurs within 14 days marked "Yes." Over 14 days up to 21 days the number of days is given.	In view of facts in antecedent columns. Opportunity for having acquired infection in the Bath is:— Affirmative (+) Negative (—) Doubtful (±).	Opportunity for personal infection in Barrack Room Affirmative (+) Negative (—) Doubtful (±).	Number of Case.
	From	To							
1	13 July	25 August ..	..	4 August ..	25 August ..	Yes.	+ . .	. — .	1
2	18 May	20 August ..	..	8 August ..	20 August ..	Yes.	+ . .	. — .	2
3	Not under	instruction.	No.	25 August ..	9 September ..	..	. — .	+ . .	3
4	24 August ..	7 October ..	..	16 September ..	7 October ..	Yes.	+ . .	. — .	4
5	7 September ..	18 September ..	..	17 September ..	21 September ..	Yes.	+ . .	. — .	5
6	Not under	instruction.	Yes.	27 September ..	28 September ..	Yes.	+ . .	. — .	6
7	4 August ..	28 September ..	..	27 September ..	29 September ..	Yes.	+ . .	. — .	7
8	24 August ..	30 September ..	..	28 September ..	1 October ..	Yes.	+ . .	. — .	8
9	22 June	24 July	Yes.	28 September ..	9 October ..	Yes.	+ . .	. . ±	9
10	9 March	17 September ..	No.	4 October ..	11 October ..	17 days.	? + . .	. — .	10
11	24 August ..	9 October ..	..	6 October ..	11 October ..	Yes.	+ . .	. — .	11
12	4 August ..	14 August ..	Yes.	7 October ..	10 October ..	Yes.	+ . .	. . ±	12
13	24 August ..	2 October ..	..	7 October ..	15 October ..	Yes.	+ . .	. — .	13
14	Not under instruction—Dead, no information.			9 October ..	13 October ..	..	. — .	. — .	14

15	24 August ..	4 September ..	Yes.	10 October ..	11 October ..	Yes.	+	.	.	.	.	±	15
16	4 August ..	2 October ..	..	11 October ..	17 October ..	Yes.	+	.	.	.	.	±	16
17	12 October ..	15 October ..	Yes.	14 October ..	16 October ..	Yes.	+	.	.	.	.	±	17
18	24 August ..	2 October ..	..	15 October ..	18 October ..	Yes.	+	.	.	+	.	.	18
19	Not under instruction—Dead, no information.			(?) 16 October ..	16 October ..	..	.	—	.	+	.	.	19
20	Not under instruction.		About 28 Sept.	19 October ..	22 October ..	21 days.	.	.	±	+	.	.	20
21	Not under instruction.		18 Sept.	19 October ..	24 October ..	No.	.	—	.	.	—	.	21
22	22 June	21 August ..	Yes.	20 October ..	26 October ..	Yes;	+	.	.	.	—	.	22
23	Not under instruction.		No.	21 October ..	23 October ..	..	.	—	.	+	.	.	23
24	7 September ..	18 September ..	No.	21 October ..	23 October ..	No.	.	—	.	+	.	.	24
25	Not under instruction.		No.	22 October ..	23 October ..	..	.	—	.	+	.	.	25
26	21 September ..	9 October ..	..	23 October ..	26 October ..	Yes.	+	.	.	.	—	.	26
27	24 August ..	19 October ..	..	27 October ..	2 November ..	Yes.	+	.	.	+	.	.	27
28	7 September ..	27 October ..	..	28 October ..	4 November ..	Yes.	+	.	.	.	—	.	28
29	24 August ..	27 October ..	..	29 October ..	31 October ..	Yes.	+	.	.	+	.	.	29
30	Not under instruction.		No.	30 October ..	1 November ..	..	.	—	.	+	.	.	30
31	Not under instruction.		No.	17 November ..	17 November ..	..	.	—	.	.	—	.	31
32	Not under instruction.		No.	(?) 15 October ..	15 October ..	..	.	—	.	.	.	±	32
33, P 1*	9 March	29 May	..	17 October ..	18 October ..	Plymouth cases, no data.				+	.	.	33, P. 1
34, P 2*	9 March	8 May (Dead.) ..	..	25 October ..	26 October ..					+	.	.	34, P. 2

* These cases developed the disease after transference from the Depôt to the Plymouth Head Quarters

This table indicates that if it may be believed that two separate though related conditions causative of enteric fever, namely an infected swimming bath and personal relation in Barrack-room with an antecedent case or cases, have been successively in operation among recruits at the Depôt, well nigh all the 34 cases occurring in the outbreak might be accounted for in the one or the other way.

The seeming exceptions are four, No 14 attacked 9th October, who died before my inquiry commenced, and from whom therefore no details of his doings antecedent to illness were procurable, and Nos. 21, 31 and 32.

No. 21, attacked 19th October was, he asserts, only once in the swimming bath, and he fixes that date as in all probability 18th September. If he be correct as to this, an interval of 31 days elapsed before his attack, and to a corresponding extent discounts bath infection. Though fever had not antecedently occurred in his Barrack-room, he was chums with Nos. 14 and 17, being like No. 17 an ex-bugler joining as a recruit from Headquarters. It is possible that through association with No. 14 he became personally infected.

Nos. 31 and 32 were not swimmers ; and No. 31 seemingly had not opportunity of Barrack-room infection. Notes on these cases are given in Appendix IX.

PRECAUTIONARY MEASURES CARRIED OUT AT THE DEPÔT ON THE OUTBREAK OF ENTERIC FEVER THEREIN.

When Colonel Commandant Wylde, R.M., took over the command of the Depôt towards the middle of October, and learnt of the outbreak of enteric fever, he, with the assistance of the Fleet Surgeon, dealt promptly with the matter. Rooms which had been principally invaded were ordered to be vacated, and with their contents to be disinfected, all drinking water to be boiled, swimming instruction to be suspended, and an old pensioner, whose lemonade had come under suspicion, was ordered to discontinue its sale inside the Depôt. The Colonel Commandant assembled the Marines in the theatre of the Depôt, advised them as to precautions against infection, and warned them against eating shellfish. As two cases of enteric fever had by this time occurred in a draft sent from the Depôt to the Plymouth Headquarters, further drafting of the Marines from the Depôt was for the time suspended. To these precautionary measures the limitation of the outbreak to small dimensions must be attributed.

A supply of anti-typhoid vaccine was obtained by the Fleet Surgeon ; a notice was published in the Depôt orders, and read on parade on three separate occasions, that any men who wished to avail themselves of the opportunity of being vaccinated against typhoid (enteric) fever could do so. Only nine men took advantage of this offer.

My inquiry involved much clerical work in the compilation of lists of recruits, details of work done by special batches of men, in analysing the swimming bath records and so forth, and for the preparation of these returns and for other valuable assistance cordially given, I have to thank Colonel Commandant Wylde and his Staff. I would also thank Dr. M. K. Robinson, Medical Officer of Health for the Eastry Rural District, Dr. Mason, Medical Officer of Health for the Borough of Deal, and Dr. Davey, Medical Officer of Health for the Walmer Urban District, for lists of cases of infectious disease notified in their respective districts, and for their readiness in placing their time and local information at my disposal. I am also indebted to Mr. H. W. Barker, Surveyor and Inspector of Nuisances for the Walmer Urban District, for particulars of the sewerage arrangements of his district, and to Mr. Page, Inspector of Nuisances for the Eastry Rural District, for information concerning the sanitary condition of Mongeham village.

RICHARD J. REECE.

APPENDIX I.

In the following table is given a list of the cases of enteric fever which occurred during the outbreak at the Depôt. For each case is recorded the age and rank of the patient, the Company and the Squad to which he belonged, the name of the Barrack, the block in the Barrack and the room in the block in which the case occurred. The date on which the patient joined the Depôt and the date of his admission to hospital are also entered, as well as the approximate date of the onset of the disease. To obtain this latter date with any accuracy proved a difficult matter, but as shown, it may be regarded as approximately correct.

The cases are divided into two series by a transverse line separating into a first series those whose dates of onset occurred during the months of August-September, from the second series occurring in October-November. It is the cases in the first series which are dealt with in detail in the text of the report.

TABLE IX

No. of Case.	AGE.	Rank.	Company.	Squad.	Barracks.	Barrack Block and Number of Room.	Date on which the Marine Joined the Depôt	Approximate date of the *Onset* of the Illness.	Date of Admission to Hospital.
1	19	Recruit	E	66	North	H 4	6 March, 1908	4 August	26 August
2	17	,,	D	63	North	G 9	28 January ,,	8 August	20 August
3	26	,,	D	67	North	G 9	2 July, ,,	25 August	9 September
4	18	,,	C	67	North	E 6	9 May, ,,	16 September	7 October
5	17	,,	F	68	North	K 6	5 June, ,,	17 September	21 September
6	17	,,	E	71	North	H 7	25 July, ,,	27 September	28 September
7	20	,,	G	66	East	N 5	30 April, ,,	27 September	29 September
8	18	,,	D	67	North	F 1	19 May, ,,	28 September	1 October
9	17	,,	E	64	North	H 4	29 February, ,,	28 September	9 October
10	18	,,	C	62	North	E 5	15 November, 1907	4 October	11 October
11	19	,,	C	68	North	E 3	20 May, 1908	6 October	11 October
12	18	,,	E	66	North	H 4	28 April, ,,	7 October	10 October
13	17	,,	A	67	South	A 3	13 May. ,,	7 October	15 October
14	17	,,	E	71	North	H 6	29 July, ,,	9 October	13 October
15	18	,,	E	67	North	H 4	9 May, ,,	10 October	11 October
16	18	,,	E	66	North	H 4	24 April, ,,	11 October	17 October
17	17	,,	E	70	North	H 6	13 August, ,,	14 October	16 October
18	18	,,	E	67	North	H 4	17 May, ,,	15 October	18 October
19	17	,,	E	74	North	H 7	26 September ,,	?16 October	16 October
20	18	,,	E	74	North	H 7	26 September ,,	19 October	22 October
21	17	,,	D	71	North	F 15	13 September ,,	19 October	24 October
22	17	,,	F	64	North	K 15	29 February, ,,	20 October	26 October
23	19	,,	E	72	North	H 4	26 August, ,,	21 October	23 October
24	17	,,	E	68	North	H 4	11 June, ,,	21 October	23 October
25	19	,,	E	71	North	H 4	8 August, ,,	22 October	23 October
26	19	,,	B	69	South	O 2	26 June, ,,	23 October	26 October
27	17	,,	E	67	North	H 7	9 May, ,,	27 October	2 November
28	18	,,	C	68	North	E 11	28 May, ,,	28 October	4 November
29	18	,,	E	67	North	H 4	28 April, ,,	29 October	31 October
30	18	,,	E	73	North	H 4	9 September, ,,	30 October	1 November
31	36	L-Corp.	Married, lived outside Barracks. Employed in Shoemakers' Shop, East Barracks.				23 years' service	17 November	17 November
32	19	Recruit	E	72	North	H 6	26 August, 1908 ..	?15 October	15 October
33 P. 1	18	,,	E	58	North	H 4	15 November, 1907	17 October	18 October
34 P. 2	19	,,	E	58	North	H 7	17 November, ,,	25 October	26 October

APPENDIX II.

(B.) *Water Supply in relation to the Fever.*

After study of a plan of the water mains and sewers of the Depôt, it appeared desirable, in view of possible local contamination of water service, to test for leakage a branch water main, laid a few feet below the surface, which passes under the drill shed behind G, H and J Blocks.

This water main was laid a few years before the drill shed was built. The shed, of large size, is supported in the centre on iron pillars, and has a solid concrete floor. It seemed possible that damage might have been done to the water main during the construction of the drill shed. A sewer which passes under this drill shed was known to be in a very leaky condition, and notwithstanding that it is laid several feet deeper than is the water main, the possibility of direct infection of the water in the main from this sewer could not be ignored. The water main, at my request, was tested by Mr. Hyatt, of the Works Department, and it was found to be water-tight.

Locally, it was considered that fever might have been spread, in part at any rate, by the practice that prevailed of emptying the urine tubs over gullies beneath the water taps from which the water supply to G, H and J Blocks is derived; that in this way the taps and the water issuing from them might have become specifically contaminated. There is the standing order already referred to which directs that all urine tubs are to be emptied in the latrines. But between the three blocks in question, two concreted areas each measuring 17 ft. 6 in. by 11 ft. 6 in., have been provided, so contrived as to afford under each of two water taps a shallow recess about 6 feet square and 5 inches deep. In this recess is a perforated grating beneath which is a trapped connexion to the drain. Seemingly provision was thus made for the express purpose of emptying urine tubs.

It was surmised that in the process of emptying these tubs, infective urine, splashing up might have soiled the two water taps, and that water drawn from them for drinking purposes, thus became contaminated. The water taps, however, are placed 27 inches above the concreted surface, a height that makes it doubtful whether in emptying the tubs the urine could be splashed on to the taps, unless under circumstances of extreme carelessness.

In Blocks G, H, and J the drinking water supply is carried in cans from one or other of these two taps for use by day and by night in the barrack rooms. These cans are also used to carry the tea from the kitchens to these barrack rooms, and between meals they are filled with water and stand in the barrack room. When a marine wishes to drink between meals, he dips a small basin, which has no handle, into the can of water. As the cans in the process of filling are either hung on the taps or placed on the gullies under the taps, there was perceived a possibility of infection having been carried to the rooms in G and H Blocks. Block J did not have any cases of fever. Be it observed however that to have caused the fever the urine splashed on the taps must have been specifically infected, or that the cans had become specifically infected from the hands of the men, or by cloths with which they were wiped out. Infection so conveyed would not, however, account for all the first nine cases which occurred. These were not limited to G and H Blocks, some of the cases occurred in blocks in which the drinking water is drawn from water taps in the lobbies. No evidence was obtained that among these first nine cases the patients from other Blocks had drunk water taken from the taps by G and H Blocks.

APPENDIX III.

(D.) *Food and drink as possible vehicles of fever*

(*a*) *Officially provided.*

Milk.—The possibility of the infection of enteric fever having been derived from some articles of diet was considered early in the inquiry. Milk is often a vehicle by which such infection is carried.

Married men occupying separate quarters purchase their own milk, and several milk vendors have permission to enter the Barracks to sell milk. But all milk provided for the use of the marines in the Barracks is supplied to the Depôt by one Contractor, Mr. Dodson, of Deal, and is pasteurized before leaving his premises.

The milk is delivered in churns at the kitchens, and is added to the tea in the coppers. No milk can be obtained by the men from the kitchen for drinking purposes, though it may be bought by them from the canteens, and no milk was so bought by the men attacked by enteric fever. Mr. Dodson's premises are kept scrupulously clean. His contracts with farmers for milk supply, drawn up by himself, contain stringent and far-reaching clauses; and he appeared to have a scientific knowledge of milk quite unusual among milk vendors. The milk is cooled at the farms and again cooled on its arrival on Mr. Dodson's premises. He assured me that he added no preservatives to the milk, but relied on cooling and pasteurising processes and on sterilization of his cans, &c. All his milk utensils are first cleansed by washing in water heated by steam, and are then placed over a steam jet; they are then set on racks to dry; they are not wiped out. I found no reason for suspecting the milk supplied to the Depôt to be the carrier of infection.

Other Food.—The kitchen arrangements of the Barracks were studied, and special attention given to the kitchen at the North Barracks. All food supplied from the kitchens is cooked, no uncooked vegetables, such as watercress, celery, radishes, &c., are supplied. Study of the diet sheets of the rations supplied in the Barracks revealed no likely opportunity for the introduction of the infection. Inquiry into the conditions associated with the storage of food, including meat and bread inside the Barracks yielded a negative result. In only one point does the food of the recruit differ from that supplied to the "old soldier." The recruit on joining and until he reaches the age of 19 receives a special evening meal. Many complaints as to the quality of this meal, which is usually boiled pork, were made to me by recruits, and the complaints thus made contrasted markedly with the strong approval expressed concerning the quality of the mid-day meal.

On consideration of all available facts I came to the conclusion that the food officially provided at the Depôt could not be in any way held responsible for the outbreak of fever.

APPENDIX IV.

(b) *Food and drink from unofficial sources as possible vehicles of infection of fever.*

There is a list kept at the Depôt of various tradesmen and others who have passes to enter the Barracks, and theoretically these passes should be produced by the holder or his agent on entering the Barracks. But in practice this is not always done. Certain of the holders of passes are well known, and are not always called on to produce their authority on entering the Barracks. There is evidence, too, that at times, unauthorised persons do enter the Barracks, possibly when recruits are on duty at the gates. Separated from one another as these three sets of Barracks are, with numerous gates through which marines are constantly passing as their duties require their presence in one or other Barracks, together with the numerous tradesmen and others who have business in the Barracks, it is by no means an easy matter to prevent unauthorised persons entering.

"*Shellfish*" were hawked in the evenings in the barrack rooms, until the Colonel-Commandant towards the end of October stopped the practice. These "shellfish" were sold by a boy, but whether he was the agent of one of the fishmongers who hold a Barrack pass I was unable to determine. In the view of Dr. Mason, the Medical Officer of Health for the Borough of Deal, several of the cases of enteric fever which have occurred this year in his district have owed their infection to the ingestion of shellfish. That shellfish might have been the vehicle by which certain of the patients in the Barracks derived their infection cannot be excluded. Such a source of infection might have accounted for two of the first nine cases which occurred, and possibly even for a third, but it would not account for the other cases in this series.

Ice creams.—In pursuing this question of "outside" supplies of food, enquiry was made concerning an Italian ice cream vendor who sold his wares from a barrow outside the barrack gates. On visit to his premises in Deal, I found that he had retired from the business, which, however, was still carried on by two other Italians. In late autumn there is no demand for ice creams, and the trade changes to baked potatoes and chestnuts. A report made to the Medical Officer of Health by the Inspector of Nuisances of

Deal, shows that sanitary defects exist at these ice cream premises, and that they are in a dirty condition. The Inspector expresses the opinion that the place is quite unsuited for preparing (for the use of man) food of any kind for sale. With this view I entirely concur.

Granted that these ice creams had been the agents by which the infection could be carried, they might be held responsible for two, and possibly for a third of the first nine cases; but they would not account for the other cases in the series.

The old pensioner's lemonade.—It was also surmised that lemonade, sold by an old pensioner who has for very many years been permitted to stand with his barrow inside the barracks, in front of H Block, might have been the vehicle by which the infection was introduced. The report to the Director-General of the Navy Medical Department on an examination made at Haslar, of a sample of this lemonade states: "Organisms were found to be present which indicated that the water used in its manufacture was obtained from a bad source, with probable sewage contamination. This lemonade is therefore unfit for drinking purposes." By the request of the Colonel-Commandant the Medical Officer of Health for Deal furnished to his authority a report on the premises where this lemonade was prepared. He states that although the sanitary arrangements of the house are not up to date, the premises are kept quite clean. This I verified myself. The lemonade is not made by the old pensioner, but by (?) his daughter or daughter-in-law. Water from the town main is used. After studying the method of preparation of this lemonade, I could not account for the presence of the organisms mentioned above, unless they were introduced in the process of washing the bottles or in mixing the lemonade, both operations being done in wooden tubs.

Assuming it to have been infective, this lemonade might have accounted for two, or possibly three, of the first nine cases in the first series.

Fried fish.—Inquiry was also made concerning "fried fish," which is sold at a shop close to the barrack gates, much patronised by the marines. These premises with regard to drainage and trade appliances, are not up to date, but no serious nuisances were discovered. Only one of the first nine cases ate any of this fried fish in weeks antecedent to his attack.

Uncooked vegetables.—None of the cases in the first series ate any uncooked vegetables, such at watercress, celery, radishes, lettuce, &c.

APPENDIX V.

(E.) *Clothing, as possible agency in transmitting infection.*

An ex-marine (F) who had been at one time a tailor inside the Barracks, and who, after he had left the service was refused a pass to the Barracks, nevertheless received at his house clothes for repairs, &c., belonging to marines in the Depôt.

The house when I visited it was in an extremely filthy condition, and there were some military clothes within the premises. It is contrary to military law, under which it is considered a serious offence, for any unauthorized person to be in possession of military clothing, and the tailor was promptly prosecuted by the Depôt authorities. Thereafter I could obtain no information from this family. I, however, ascertained that the tailor, who is a widower, nursed his son with enteric fever for some three weeks before the lad was removed to the Civil Isolation Hospital, and that during the time his son was ill in his house, he had had in his possession certain clothes for alteration, which belonged to the second recruit attacked in the Depôt, and that the date of attack of this case was consistent with his having derived his infection from the clothes returned to him by this tailor. I am not aware that any case of enteric fever has been attributed to infection derived from wearing specifically infected clothing, but that such a possibility exists cannot be denied.* In this connexion the circumstances associated with the South African army blankets, and the occurrences at the training ship " Cornwall " might be borne in mind.

Not any other of the first nine sufferers had recently had dealings with this tailor.

APPENDIX VI.

(F.) *Opportunities of personal infection from case to case.*

Only in G and H Blocks of North Barracks did more than one case occur in a barrack room. Thus, out of the total number of 34 cases, 11 which occurred in different rooms, and the three who were each the first cases to be attacked in rooms where subsequently other cases occurred, could not be accounted for as deriving their infection from antecedent cases in their rooms. In one room, H 6, it is probable that the three cases derived their infection at or about the same time, and therefore that one could hardly have infected the others.

H 4, in which over the whole outbreak the greatest number of cases occurred, is a long room, containing accommodation for 29 marines. The " old soldiers " in charge of the room all slept towards one end of the room. If the number of recruits in the room were below the number which the room can accommodate, they slept in beds situated toward that end of the room which is occupied by the " old soldiers," apparently for easier supervision. When a man left the room and the bed thus vacated was at the " old soldiers' " end, it was filled by moving a man into it from the other end of the room. It thus happened that as some of the men were removed to hospital their beds were occupied by other inmates of the room. No change of mattress, bolster or blankets appears to have been made in such cases, although in some instances the man taking another's bed brought his own sheets with him.

---

* The typhoid bacillus is capable of saprophytic existence in soil, dust, water, and milk, and may persist in the excreta for months. It can survive in ordinary earth for two months, on sterilized linen for 60 days, on woollen cloth for 80 days, in sterilized water for 196 days, and in certain soils 400 days. (Whitelegge & Newman, 1908.)

Enteric fever does not appear in the list of fevers regarded as infectious in the medical regulations of the Navy, and the bedding of the men removed to hospital with enteric fever was not disinfected nor the straw of the mattresses burnt until the 25th of October. On that date the Colonel-Commandant, who had just taken over the command of the Depôt, ordered H Block to be vacated, and the room and its contents to be disinfected.

The cases which can be regarded as not unlikely to have derived their infection from antecedent cases in the barrack rooms numbered 12. These 12 were most of them attacked after the outbreak had become fully established.

APPENDIX VII.

(G.) *Antecedent cases as possible carriers of the disease.*

Inquiry was made to ascertain whether any person had possibly been acting as a " carrier " of infection, whether within or outside the barracks. In this way the medical history sheets of all men employed in the kitchens, and those of several others, who for one or another reason came in any way under suspicion, were examined with a view to determining whether at any antecedent period of their service they had suffered attack by enteric fever.

Only one man was discovered who could be thought of as possibly a " carrier " of infection. This was a recruit who joined the depôt on 12th August, 1907, and went into hospital on 17th September, 1907, suffering from enteric fever. He remained in hospital until 7th January, 1908, when he went on six weeks leave of absence. On his return in the first week of March he resumed his ordinary training as a recruit. After the outbreak of fever occurred at the Depôt this recruit was segregated in hospital, as, on examination, his blood showed a positive Widal reaction. It is well known that after attack by enteric fever the blood of a patient may afford this reaction, persistently for many months; while at the same time the excreta may be found entirely free from the bacillus typhosus. A sample of this man's fæces was sent by me to Dr. Ledingham, the bacteriologist, engaged by the Local Government Board to make special bacterial study of the fæces of convalescent enteric fever cases. The bacteriological examination of the sample gave a negative result.

This man, after his return from furlough, and before he was isolated in the hospital, had done the ordinary work of a recruit, which included acting as " cook " in his barrack room. This room was in a block in the East Barrack, and no cases of enteric fever occurred in it. He was in no way associated with the first series of cases.

APPENDIX VIII.

Fever outside the Barracks antecedent to, and concurrent with, the outbreak within the Depôt.

The sanitary districts which surround the Barracks are the Borough of Deal and the Urban District of Walmer. Further to the westward is the Rural District of Eastry, which, on the land side, encompasses these two Urban Districts.

From Drs. Mason, Davey and Robinson, the Medical Officers of Health to these three districts, I obtained a list of cases of enteric fever which in 1908 had been notified in their respective areas, with particulars of each case.

A.—*The Borough of Deal.*—After freedom of the district from enteric fever for some time, a child was notified as suffering from that disease on 12th July, 1908. Infection in this case, I learn from Dr. Mason, was considered as probably derived from infected shellfish. A second case, clearly an imported one, was notified on 31st July. Neither of these cases appeared to be in any way connected with the outbreak in the Barracks. No further cases were notified in Deal until the 10th September, when another case was reported. This, however, was an " imported " case. On 11th of September the child of a publican in Deal was notified as suffering from enteric fever, and later the publican and another child were attacked by the disease. Although the publican was an ex-marine, and, as I was informed, an honorary member of the Sergeants' Mess at the Depôt, these cases appeared to have no connexion with the Barrack cases, and they occurred after the first cases at the Depôt. The source of infection at the Depôt could not be referred to the Deal town cases, nor so far as I could judge could these first cases in Deal be attributed to the Depôt cases.

B.—*The Eastry Rural District.*—A case was notified on 25th September, 1908, followed on 1st November by a second case (the fifth case in the district) in the same house. The second case was notified on 8th October, the third case on 22nd October. These cases all occurred in the village of Mongeham. Later a fourth case was notified on 31st October at a house some distance from this village, and no connection with the prior cases nor with the Depôt was traced.

These cases although they occurred subsequently to the first cases at the Depôt nevertheless are of some interest. It is to " Z's " farm in this village that the refuse food, ashes, &c. from the Depôt are taken. The refuse Depôt food is here boiled in preparation of food for pigs. On an average some hundred pigs are daily fed in part from this refuse, the waste of bread at the Depôt being very great. The other refuse on arrival at the farm is screened and sorted, the cinders are sold for making bricks, old mineral water bottles are returned to the firms whose names they bear, and a considerable quantity of old military clothing, worn-out boots, &c., which find their way to this farm are disposed of for profit. I am informed by Dr. M. K. Robinson that flies swarm on and around this farm during the summer months, and this statement is supported by other trustworthy observers. At the time of my visit to this farm at the end of November I saw very few flies. Dr. Robinson considers that it is impossible to exclude these flies as carriers of infection in the cases which occurred in the village of Mongeham, and he regards the refuse of the Depôt as the indirect source of their infection. The first case which in point of time (September) occurred in this village was in a cottage abutting on which is a field where certain of the Depôt refuse was used as manure, and the interior of this cottage was, at the time when the case occurred, said to be black with flies. The second case occurred in a cottage separated from the farm by the breadth of a road, and the third case was the daughter of farmer Z. She, however, had assisted to nurse the second case.

C.—*Walmer Urban District.*—The first two cases of enteric fever which occurred in 1908, in the Walmer Urban District, were a woman (Mrs. G.) and her husband (G.), a sergeant of marines who is transferred to the reserve. He went to do his annual training at Devonport, from 2nd to 9th May, and his wife went with him. During her stay at Devonport she ate shellfish daily, and her infection is attributed to this cause. After their return to Walmer Mrs. G. became ill on 16th May, consulted a medical man (Dr. H.) on 24th May, was notified as suffering from enteric fever on 31st May, and died on 8th June. She was not removed to hospital, but was nursed at home by her husband.

During the third week in June, G. himself felt ill and sought medical advice. At that time Dr. H. considered that want of sleep and anxiety accounted for G's. condition. When consulted again on 19th July he formed the opinion that G. was suffering from a recrudescent attack of enteric fever, and as examination of his patient's blood gave a Widal positive reaction, he, on 22nd July, notified G's. case as one of enteric fever, and G. was removed to the Civil Isolation Hospital.

G. is employed in the Works Department at the Depôt. He is an intelligent man, and, I should say, quite reliable in his statements. He informs me that he was engaged after his return from Devonport in painting the outside of the stables and of certain buildings in the East Barracks, &c., and that he did not enter any of the barrack rooms. His wife did not take in any washing.

The third case, which occurred in the *Walmer Urban District*, was that of a boy (W.F.), the son of the tailor F. mentioned in Appendix V., p. 24. He worked at Z.'s farm, and was employed in screening the barrack refuse. The date of this boy's attack is antecedent to the Mongeham cases. This boy I failed to see, and for a reason which appears in Appendix V. of this Report, I was unable to get any direct evidence from him. It was possible to fix the first week in July as the date at which he was last at the farm. He appears to have been frequently discharged by the farmer for carelessness in his work, but he came back again and again after dismissal. After being dismissed in July, he did not again come to work at the farm. The boy was notified as suffering from enteric fever on 22nd July, and removed to the Isolation Hospital on 23rd July. I learn from Dr. Davey that the boy had been ill in bed at home and nursed by his father, who is a widower, for about three weeks before his illness was notified. He probably ceased work at the farm owing to inability to walk the distance, about three miles, between his home and the farm. It remains an open question whether this boy contracted his infection in Walmer and carried it to Mongeham, or acquired it while at work at the farm.

The points of interest in these Walmer cases are (1) that both G.'s house, and the house of the tailor F. are connected to the Walmer sewers which join the main outfall sewer after it has passed out of the South Barracks. And (2) that the excreta from enteric fever patients, passed, untreated with disinfectants, to the sewers from about 16 May to 31 May and again from 21 June to 23 July.

APPENDIX IX.

Particulars of Cases 32 *and* 31.

With regard to No. 32, it is quite possible that he derived his infection from the same source and at the same time as did Nos. 14 and 17. Like Nos. 14 and 17 he was an inmate of Block H, Room 6, and he was admitted to hospital on 15th October. His illness was then regarded as an acute attack of nephritis. But this may have been, as it sometimes is, the first symptom of a severe attack of enteric fever.

At that time the cases of enteric fever under treatment at hospital had not been isolated in a separate ward, as was afterwards done, and when admitted No. 32 was received in a ward where cases of enteric fever were under treatment. By 21st November the attack of nephritis had subsided, but the patient's temperature rose, and on 22nd November a Widal examination of his blood was made, and found to yield a positive result. It is, therefore conceivable that No. 32 acquired the enteric fever infection while in hospital.

No. 31 was a lance-corporal, aged 36, a married man resident outside the barracks, and he worked in the shoemaker's shop in the East Barracks. Locally it was considered that this man might have received his infection at the shoemaker's shop. It was part of his duty to receive the shoes, boots, &c., which were sent for repair to the shoemaker's shop, to examine these boots, mark them for repairs required, check them off and so forth. In this way he received the boots of several men who afterwards developed enteric fever. It was thought that these boots might have carried infection through soiling with infective urine or fæces. The following table gives the number of each patient whose boots were repaired, the dates on which the boots were received and re-issued, the date of attack and of removal to hospital of each patient.

No. of each patient.	Date on which his boots were received for repairs.	Date on which the boots were re-issued.	Date of onset of the patient's attack by enteric fever.	Date of his removal to hospital.
9	10 September...	21 September...	28 September	9 October.
9	30 September...	12 October ...		
10	15 September...	28 September...	4 October ...	11 October.
12	23 September...	5 October ...	7 October ...	10 October.
15	16 September...	28 September...	10 October ...	11 October.
22	20 October ...	2 November...	20 October ...	26 October.
25	7 October ...	19 October ...	22 October ...	23 October.
27	23 September...	5 October ...	27 October ...	2 November.
29	2 September...	14 September...	29 October ...	31 October.

The date of onset of illness in Case 31 was 17 November.

On assumption that Case 31 was infected through boots received by him, he could hardly have become so infected except through Case 22. Case No. 22, however, only commenced to feel ill on October 20th the date on which his boots were received for repair, and he had been removed to hospital before his repaired boots were re-issued on 2 November. It is doubtful whether No. 31 could have acquired infection from handling these boots.

This man and his wife were both questioned as to possible source of infection without any result being obtained.

R. J. Reece.

LONDON:
PRINTED FOR HIS MAJESTY'S STATIONERY OFFICE,
By DARLING & SON, Ltd., 34-40, Bacon Street, E.

1909.